U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 156.

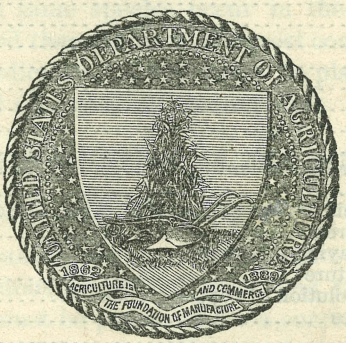
THE HOME VINEYARD,

WITH SPECIAL REFERENCE TO NORTHERN CONDITIONS.

BY

W. H. RAGAN,

Special Agent, Bureau of Plant Industry, Pomological Investigations.



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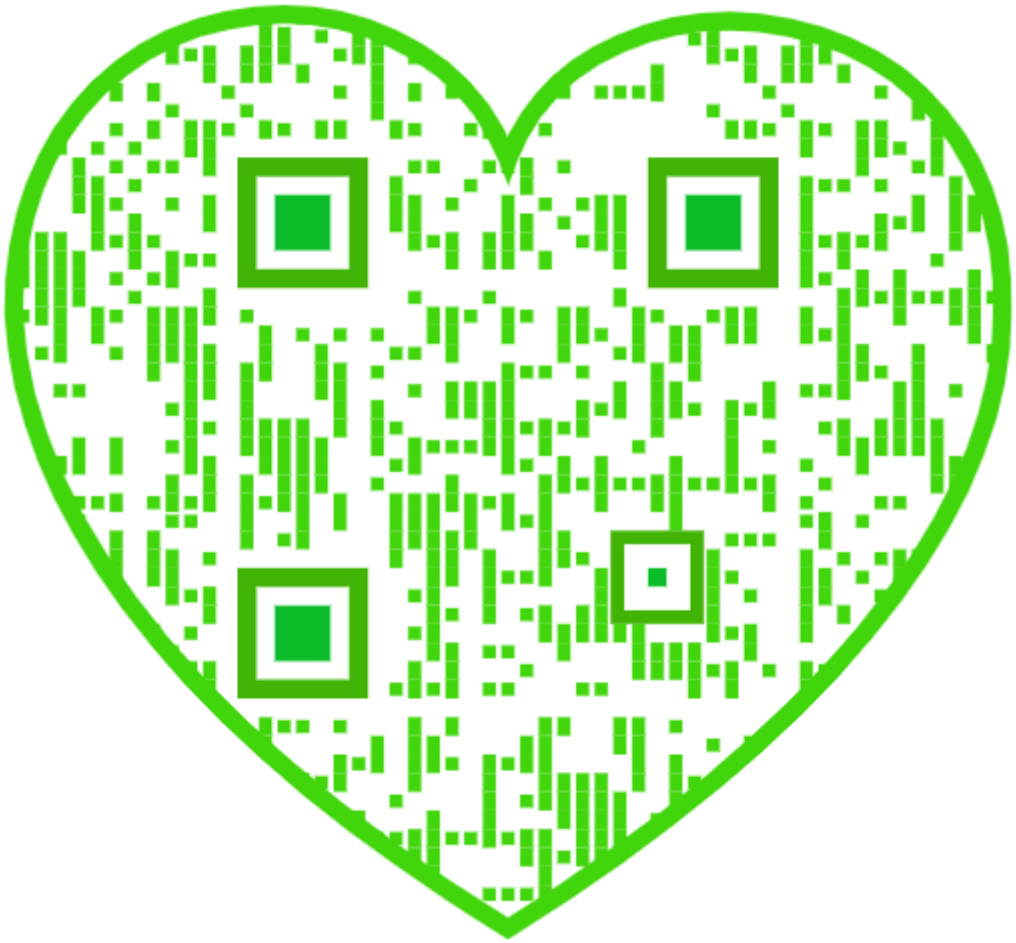

LETTER OF TRANSMITTAL.

BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., June 15, 1902.

SIR: I transmit herewith a paper, submitted from the Office of the Pomologist, on The Home Vineyard, with Special Reference to Northern Conditions. The paper was prepared by W. H. Ragan, special agent of this Bureau, engaged upon pomological investigations, and is written for the guidance of persons who wish to grow grapes in a small way rather than for the extensive vineyardist. I respectfully recommend that the paper be published as a Farmers' Bulletin.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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B. P. I.—34.

THE HOME VINEYARD, WITH SPECIAL REFERENCE TO NORTHERN CONDITIONS.

INTRODUCTION.

The grape should be more frequently found growing on the farmer's premises. It is of easy culture and brings almost certain reward for the care and attention bestowed upon it. It is a mistaken notion that its culture requires special skill and knowledge beyond his abilities. It is hoped this bulletin may help to remove this erroneous impression from the minds of farmers and thus render the grape more popular with them.

While the grape succeeds best in warm, well-drained, and fairly fertile soil, there are few farms on which it may not be successfully grown in quantities sufficient for home use; and it is not anticipated that the average farmer will cultivate it much beyond this limit.

LOCATION.

The location of the vine (for the farmer may plant but one) or the vineyard should be determined with reference to its convenience to the home and to the fitness of the soil. The preference should be given to warm, open soil, free from excess of moisture, and fairly fertile. A south or southeastern exposure will usually give greatest satisfaction. If wild vines of the same species occur in the vicinity they will be found to have planted themselves in the most congenial soil, and therefore afford a sure indication of the place to plant. This is specially true where the wild vines are succeeding well.

PREPARATION OF THE SOIL.

DRAINAGE AND BREAKING UP THE SOIL.

The grape is a trailing shrub, capable under favorable conditions of making an enormous growth of wood and fruit. To enable it to do its best the soil must be prepared for a corresponding growth and development of its root system. Grape roots are not found deeply embedded in the soil, but they are numerous and slender, and ramble or wander to great distances in search of an abundant supply of plant food. If the soil is hard and compact it will be difficult for the roots to find the proper food supply to produce satisfactory crops of fruit.

Thus the importance of thoroughly pulverizing the surface and subsoil is apparent. The thorough pulverizing of the soil in connection with tile underdraining is a well-known safeguard against the evil effects of excessive moisture as well as protection against excessive drouth.

The first work in preparing the site chosen for a vineyard, especially if it be on clay soil, will be its thorough underdrainage by tiling. The size of the tile to be used should be determined by the extent and area to be drained. Three-inch tiles will generally be found sufficiently large. They should be laid so as to afford an easy escape for the water by having an outlet in some near-by ravine or on a slope. They should be laid at least 3 feet below the surface of the ground and in parallel lines about 2 rods (33 feet) apart. This, if well done, will effectually free the soil from any surplus water that may have been held in suspension.

After thorough drainage the ground is ready for breaking. A strong team of two or three horses and a good breaking plow, with a second team and subsoil plow to follow in the same furrow, will be an effectual and labor-saving method of procedure. It is understood that a subsoil plow does not throw the cold subsoil up to the surface, but simply loosens and allows it to remain, where it properly belongs, in the bottom of the furrow.

If the site is to be prepared by hand by the use of a spade, the same rule should be observed; turn the lower spit or spade of earth at the bottom and keep the warm surface soil on top. If in preparing the soil as above directed a liberal supply of compost or well-rotted manure is worked into it, it will be improved.

FERTILIZERS FOR THE GRAPE.

As fertilizers for the grape unleached hard-wood ashes and well-composted barnyard manure will be found among the cheapest and best. These are recommended both on account of cheapness and general accessibility as well as for their constituent elements of plant food. They should be used liberally and should be well mixed with the soil in its preparation before planting; they may be used afterwards as top dressing to be worked into the surface in the process of cultivation. Leaves, soap suds, old leather scraps, and lawn rakings have also been found beneficial to the growing vines. Such coarse articles should be worked into the subsoil below the level to be affected by subsequent culture, where they will decay slowly and will not be pulled to the surface by the tools used in cultivating the vines.

Commercial fertilizers of various kinds and manufacture are now accessible to most farmers who may desire to use them, but as they are well adapted to use as surface dressing, and generally with special objects in view, they may be applied at any time after the vines are planted. A full discussion of commercial fertilizers here seems unnec-

essary and impracticable. Their use, however, should not be discouraged and their special properties should be studied and understood. The Department of Agriculture and many of the State experiment stations have published bulletins on fertilizers that may be obtained gratuitously upon application. They will be valuable aids in the study of the subject.

PROPAGATION OF THE VINE.

As a rule the farmer is advised to obtain the few vines he may wish to plant for family use from some reliable near-by nurseryman, who will be qualified and willing to help him in the selection of varieties suited to his locality, rather than to attempt to propagate them for himself. He should, however, know and understand the more simple methods of propagation, and then, if opportunity offers, he can put his knowledge into practical use by propagating them for himself. Most varieties of grapes are easily propagated by one or both of two simple methods that are in general practice, viz, by layering and by cuttings.

PROPAGATING BY LAYERS.

All varieties of the grape may be propagated easily by layering. The process consists in bringing a branch of the growing vine into

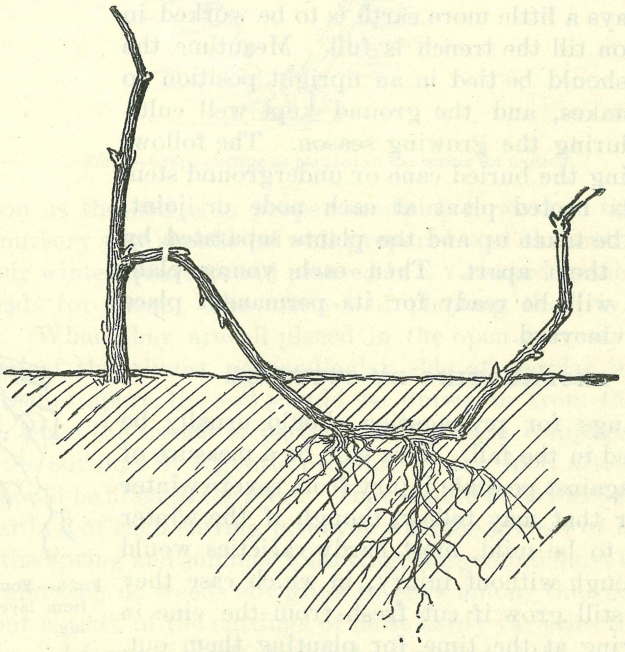

FIG. 1.—Layer of grapevine with shoot of mature growth.

direct contact with the soil and holding it in that position until roots are thrown out at the point of contact, after which the newly formed

vine or plant may be cut loose and transplanted to any desired place where it is intended to grow. One growing season will be required for the root system to be sufficiently perfected for severing the new plant from the mother vine. This method of layering will be more clearly understood by reference to the annexed illustration (fig. 1).

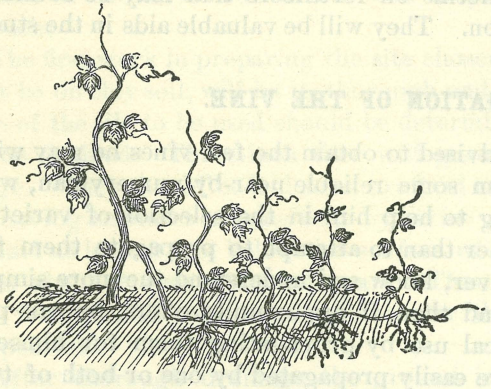

FIG. 2.—Layer of grapevine from new growth.

Layering should be done in early spring. It will be seen by reference to the next illustration that a number of plants may be made from one cane or shoot of the previous year's growth of wood. This is accomplished by placing the cane, when the buds have fairly started, in a shallow trench about 3 inches deep (fig. 2). After the shoots have grown a few inches a little earth should be drawn into the trench filling about the vine and the base of these growing shoots. In a few days a little more earth is to be worked in and so on till the trench is full. Meantime the shoots should be tied in an upright position to small stakes, and the ground kept well cultivated during the growing season. The following spring the buried cane or underground stem with its rooted plant at each node or joint, should be taken up and the plants separated by cutting them apart. Then each young plant (fig. 3) will be ready for its permanent place in the vineyard.

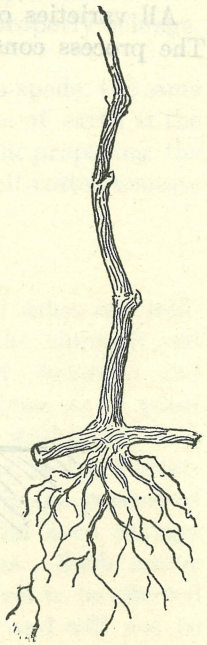

FIG. 3.—Young grapevine cut from layer for transplanting.

PROPAGATING BY CUTTINGS.

Cuttings for propagation should usually be prepared in the fall. This will be a measure of safety against possible injury from severe winter weather that may follow, though if the winter proves to be mild, most hardy varieties would go through without injury, in which case they would still grow if cut fresh from the vine in the spring at the time for planting them out. Cuttings should be made about 1 foot in length or long enough to include three or more joints. They should always be made from a shoot of the last year's wood, called a cane.

The first cut, beginning at the base of the cane, should be made about half an inch below the lower eye or bud, then draw the cane forward to the desired length and cut off again below the bud in the same manner and so proceed until all the cane is divided into cuttings. The lower or butt end of each cutting will be thus recognized by its short and uniform length below the bud, while the upper end will have a longer stem or spur extending above the upper bud. This fact, if remembered, will always enable the planter to determine which end of the cutting is the lower end, the one to be inserted in the ground.

If the cuttings are made in the fall, as they usually should be, they may be tied in bunches of convenient sizes and buried in a dry place in the garden by covering them completely with fresh, clean garden soil, until time for planting in the following spring. Great care should be taken not to place them where they will be covered by stagnant water at any time during the winter.

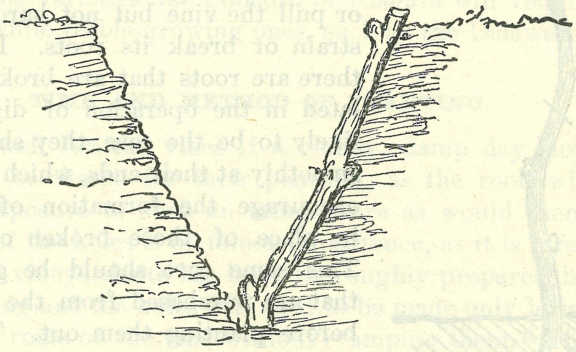

FIG. 4.—Grape cutting as planted in the spring for rooting.

As soon as the soil is in proper condition to work in the spring, a bed or nursery row should be well prepared and the cuttings taken from their winter quarters and planted in a V-shaped trench which is made ready for them. The method of planting them is illustrated in fig. 4. When they are all placed in the open furrow, by leaning them against the almost perpendicular side at regular intervals of about 4 inches apart, the soil should be drawn in from the opposite side and, when the trench is partially filled, made compact about the base of the cuttings by a gentle pressure of the foot, after which the trench should be filled to the level. They should be so placed as to bring the upper bud of each cutting just even with the surface of the ground. During the spring and summer following, the ground must be well cultivated, allowing no weeds nor grass to grow among the young plants. Many, but not all, of the cuttings of most hardy varieties thus treated will grow and form good plants for the vineyard at the end of the first year. They are seldom so good for transplanting after they have stood the second year in the nursery.

PREPARING THE YOUNG VINE FOR TRANSPLANTING.

If the farmer has grown his own vines the first step in transplanting them to their permanent places will be to dig them from the nursery or plant bed where they have grown. And here great care must be observed or the roots will be badly mutilated. It has already been said that grape roots are long, slender, and numerous and that they naturally spread near the surface of the ground. If the spade is inserted near the vine the roots will be cut short and fatal consequences will probably follow the operation of transplanting. Set the spade not nearer than a foot from the young plant and work under it from this point of beginning; at the same time gently lift or pull the vine but not hard enough to strain or break its roots. If, however, there are roots that are broken or mutilated in the operation of digging, as is likely to be the case, they should be cut smoothly at their ends, which will greatly encourage the formation of new roots in place of those broken or cut away. This same care should be given plants that are purchased from the nurseryman before planting them out. The illustration (fig. 5) represents a young grape vine already dug and prepared for planting. It will be observed that its top is marked for cutting back the previous year's growth of wood to a spur of two buds. If the young vine has been neglected in the nursery and allowed to form several shoots they should all be cut back in the same manner.

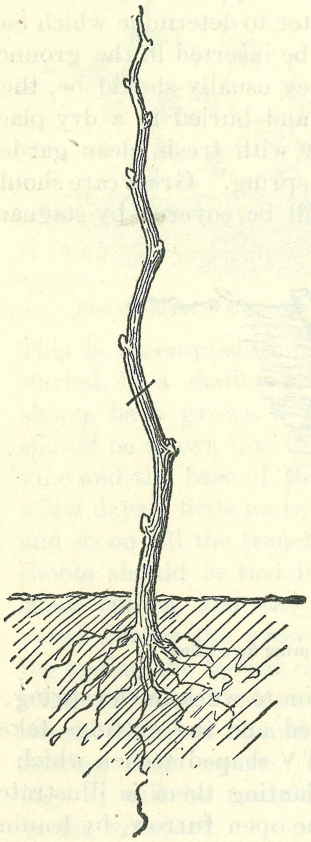

FIG. 5.—One year old vine, with mark showing where it should be cut back.

Care should be taken in these operations to guard the roots of the vine from all avoidable exposure to sun and wind. When a plant is dug and its roots and top pruned as above directed, and it is made ready for planting, in case it is impossible to plant it at once, its roots should be immediately covered with fresh earth or otherwise protected until it is wanted for planting.

PLANTING.

DISTANCES BETWEEN THE VINES.

Farmers almost invariably use horse cultivators. It will be well, therefore, to plant the vines, when more than a dozen in number, with this fact in view. It is inferred that the vineyard will be subordinate to the general farming operations; hence the vines should be planted in long lines or rows for convenience in using the horse and cultivator in their culture. The proper width of rows will be 7 or 8 feet, about double the space allotted to several ordinary farm crops. Then the cultivator may pass, if necessary, directly from the adjacent field crops and through the vineyard rows. This will establish the distance apart of the rows of vines, and the average distance between vines in the rows may be safely fixed at 8 feet, though this will depend somewhat upon the system of training intended and the varieties to be planted. Strong-growing varieties like Concord or Niagara will require a little more space, while feeble-growing ones, such as the Delaware, may do well with less.

TIME AND METHOD OF PLANTING.

It will be well for the vines if a cloudy, damp day (not wet) in spring or fall be chosen for their planting, as the roots will be less injured by exposure to such an atmosphere as would then prevail. The digging of the holes is of minor importance, as it is inferred that the soil of the vineyard site has been thoroughly prepared before the time of planting and the holes will need to be made only large enough to receive the roots of the vine without cramping them. The bottom of the hole may be made a little higher in the center so that the roots of the vine, when it is placed on this highest point, will be a little deeper at their outer end. They should be evenly distributed so they will start out in every direction from the vine, their common center, as they were originally formed. Fill in about the roots with well-pulverized soil and the work of planting is accomplished. The plants should be set a little deeper than they stood before they were taken up for transplanting.

SUPPORTS AND TRAINING.

The support for the young vine at first may be temporary, a mere stake or pole sufficiently strong to bear its weight and tall enough to train it in an upright position for one or two seasons. During this time it should be trained as a single shoot, from which all lateral or side branches are pinched off as soon as they are formed. These lateral or side branches will start at a point above each leaf and will be very easily broken off if attended to early.

At the end of the first year's growth of the young vine, treated as above directed, it may be expected to resemble that in the illustration

(fig. 6). A well-cultivated vine of the Concord or some equally strong-growing variety should then be from 5 to 10 feet in length.

Its treatment the following or second year will depend somewhat upon the training intended. In any event it should be cut back in the fall or winter of the first year to within about 2 feet of the ground. The proper place is indicated by the cross line in fig. 6.

Only the two upper buds should be allowed to grow for the second season, and they should be treated as the single shoot of the previous

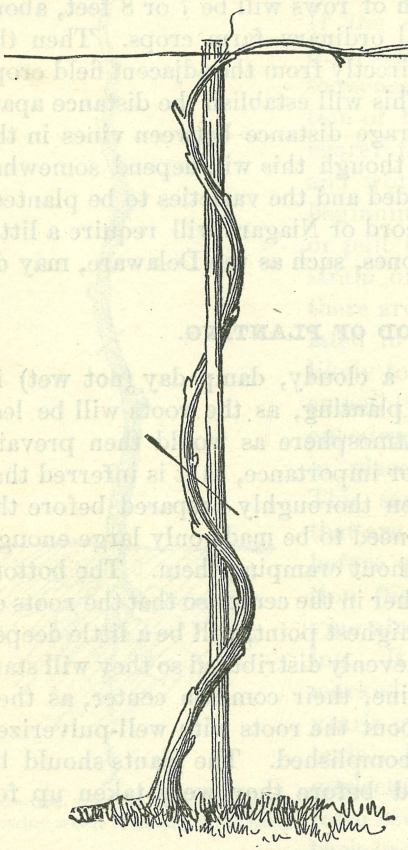

FIG. 6.—First year in vineyard; mark showing where to cut back.

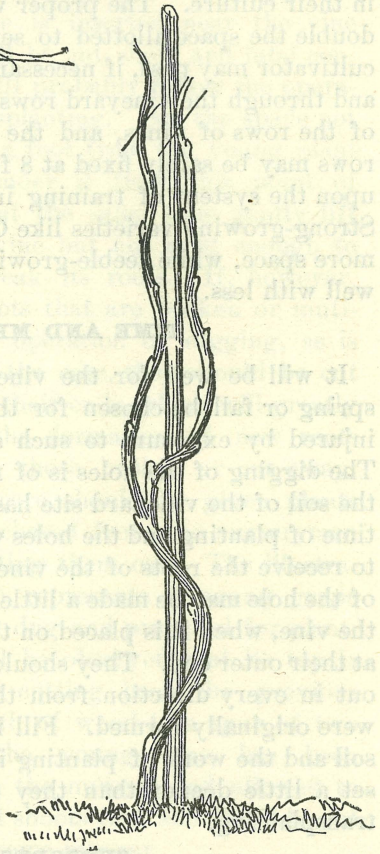

FIG. 7.—Second year in vineyard; marks showing where to cut back.

year was; that is, by training them to single shoots. If the vine, now in its third year's growth from layer or cutting, is a strong one it may be allowed to bear a cluster of fruit on each of the two shoots of wood of this year's growth. In the fall or early winter each of these two shoots (now called canes) should be cut back to about 2 feet in length. The vine will then have its stem and two branches or canes cut back to an even length, as they are intended for the permanent horizontal arms of the vine that is to be. The vine will now appear something as shown in fig. 7.

PERMANENT SUPPORTS.

The vine has now passed its second year in its permanent location and is ready for a more enduring support. This may be a stake, a building, or a trellis. The stake is now almost obsolete, having been superseded by the trellis, made cheaper and really better than the stake through the use of wire in its construction.

TRAINING ON BUILDINGS.

Many farm buildings, and even the dwelling itself in some instances, may be utilized in supporting a vine or vines, and in not a few cases,

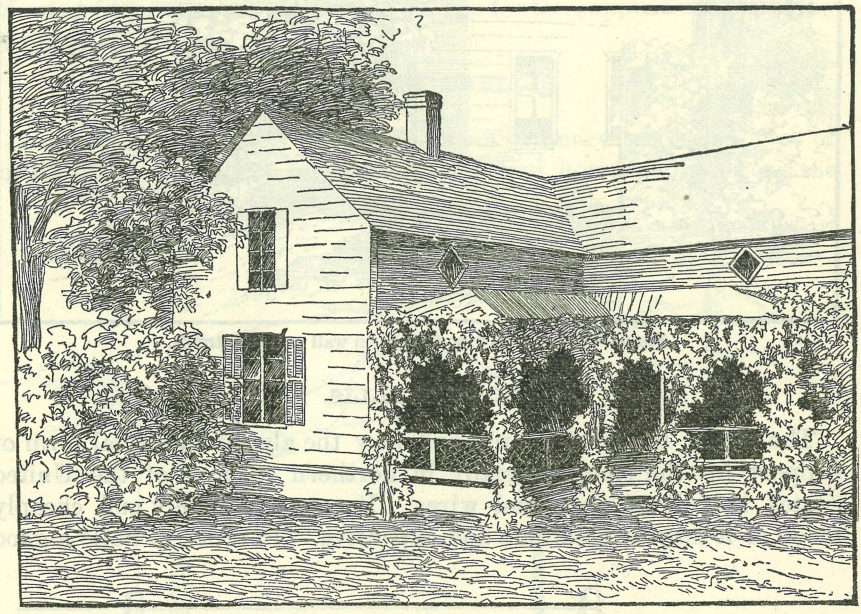

FIG. 8.—Cottage showing method of training vine on back porch.

would be made more beautiful thereby (figs. 8 and 9). If the vines are to be trained on the walls of buildings, they should be planted in a well-prepared border or bed, a few inches from the foundation, and the eaves should have gutters to carry the excess of water away from their roots. The vines should be securely attached to the wall to prevent them from giving way under the weight of fruit. A strip of woven wire may be attached to the wall and the vines tied or fastened to it. In this way the building will not be damaged by fastening the vines directly to the wall. With buildings of little value the vines may be made fast by tacking strips of old leather or even cloth over the branches and against the walls at convenient distances apart. A wall, because of its warmth and dryness, is an excellent place to grow

fine grapes, and if the vine so planted is properly trained and cared for it will become an object of beauty and a joy to the farmer's household.

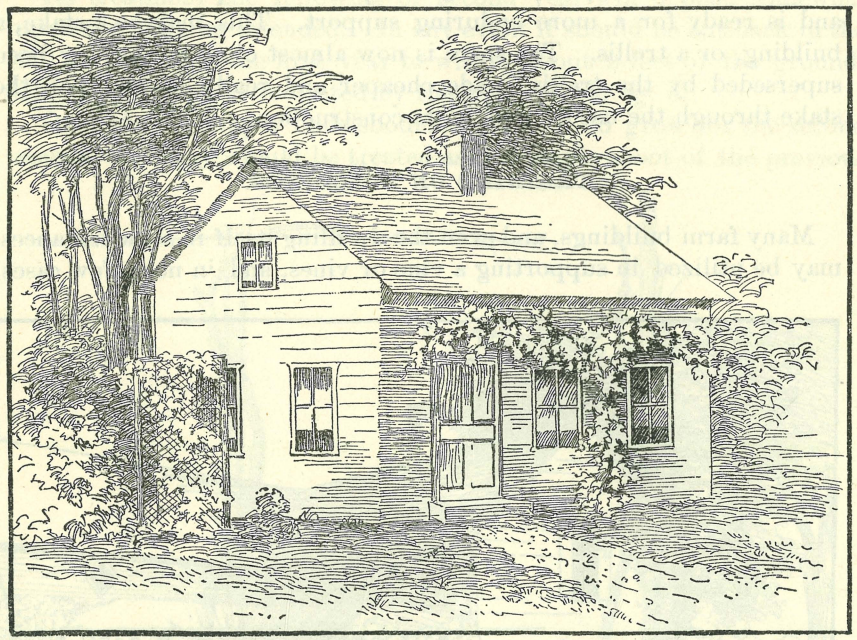

FIG. 9.—Cottage with vine trained on wall and wire trellis.

THE TRELLIS.

The trellis, the most simple and now the almost universal form of support for the vine, especially in northern sections of the United States, is built of posts and wires. It may be plainly and cheaply made or it may be elaborate and expensive. In order to build a good

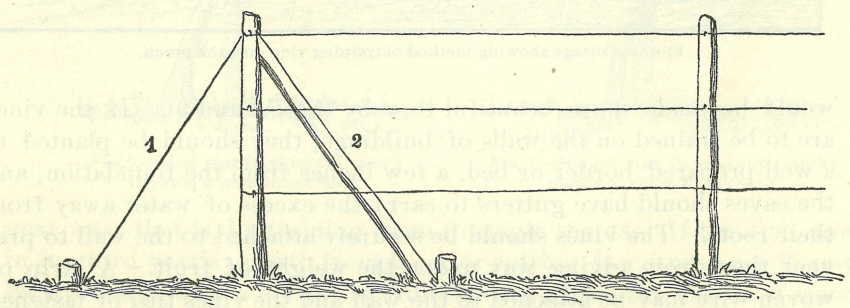

FIG. 10.—Trellis for grapevines, showing two methods of holding post in place, by brace or wire.

trellis the posts must be made of durable timber, well set in the ground, and firmly braced to prevent sagging of the wires under the weight of the vines and fruit. The end posts must be securely braced. Two methods of bracing a trellis are illustrated in fig. 10. The wire used

in constructing a trellis may be of any size from No. 12 to No. 8. Though the latter will cost a trifle more, it will be much the best in the long run. From three to five strands of wire will be sufficient for a good trellis.

THE ARBOR.

The arbor, which is really a double trellis, connected overhead by a wooden frame, covered with wire netting or wires drawn across the top, may be desirable near the house or in the garden. The vines are trained to an arbor as they should be to any ordinary trellis, except that they are allowed to meet overhead. In this way a shady bower is produced which is very agreeable in hot, sunny weather, while it affords a wider expanse of vine and foliage for the support and maturing of the fruit.

THE CANOPY TRELLIS.

A single line of posts are set as for an ordinary trellis. Pieces of scantling about 2½ feet in length are spiked horizontally across the

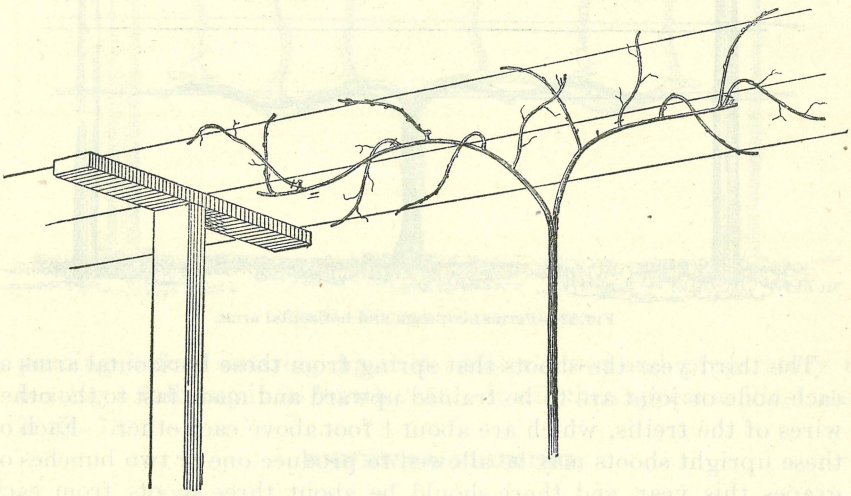

FIG. 11.—The canopy system.

top at right angles to the line of the trellis. On the upper side of these cross or horizontal pieces three wires are strung, one at each end and the third in the middle. The illustration (fig. 11) will make this clear. The vine is trained to the center wire in a single stem, at which level its top or arms are formed. The shoots or bearing wood of the vine droop or hang over the other wires. In some parts of the country, especially in large portions of the South, this form of trellis is very popular with vineyardists. They claim it protects and shades the fruit from the injurious effects of the hot sun.

TRAINING THE VINE.

Referring again to the young vine at the end of its second year in the vineyard, with its two branches or canes of that year's growth cut back to a uniform length of about 2 feet (fig. 7), it will be seen that its stem or first year's growth of wood was cut back to about 2 feet, and at this height its two branches of second year's growth were started. The trellis is now built with its lower wire at the same height as the stem of the vine, or about 2 feet from the ground. The branches of the vine grown the second year and intended for its permanent arms are turned down and fastened horizontally to the first wire of the trellis in opposite directions. (Fig. 12).

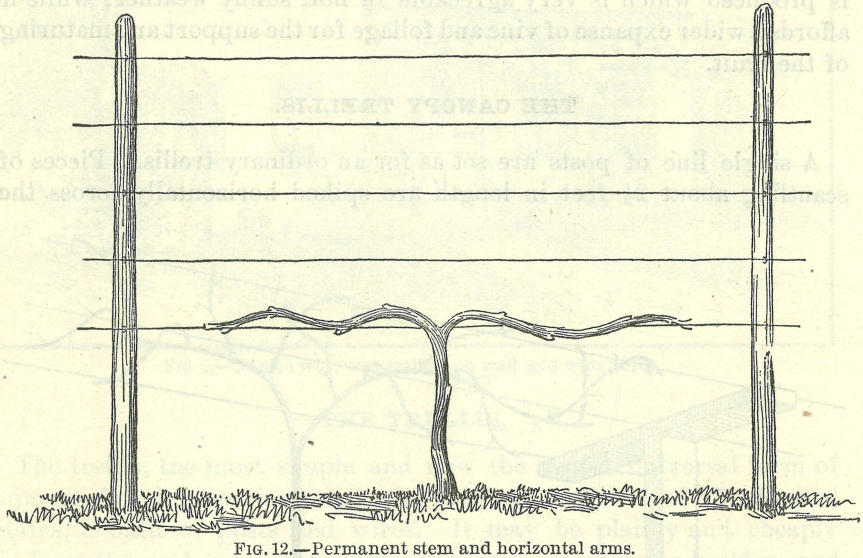

FIG. 12.—Permanent stem and horizontal arms.

The third year the shoots that spring from these horizontal arms at each node or joint are to be trained upward and made fast to the other wires of the trellis, which are about 1 foot above each other. Each of these upright shoots may be allowed to produce one or two bunches of grapes this year, and there should be about three shoots from each arm of the vine, or six in all.

If the vine is attached to a building or wall the same plan of training will be followed in developing its permanent parts. The horizontal arms with their upright shoots can be formed on the wall or building just as they should be on the trellis or arbor.

PRUNING.

In adapting the vine to our wants and requirements radical changes in its habits are necessarily forced upon it. In a state of nature it will mount to the top of the tallest object within its reach, in order to secure

to itself the light and sunshine that it requires to perfect its growth of wood and fruit, and as its fruit is always borne on the current year's shoots, the grapes would be far out of reach when harvest time came. In order, therefore, to restrain its natural habit, and to adapt it to domestic requirements, the vine must be pruned into a shape better adapted to our wants.

In the autumn of the third year the vine is fully established, with its permanent upright stem and its two horizontal arms, each with its three or four shoots or canes trained upward to the top wire of the trellis each of which has borne one or two bunches of grapes. When autumn frosts suspend vegetation the vine is ready for its annual

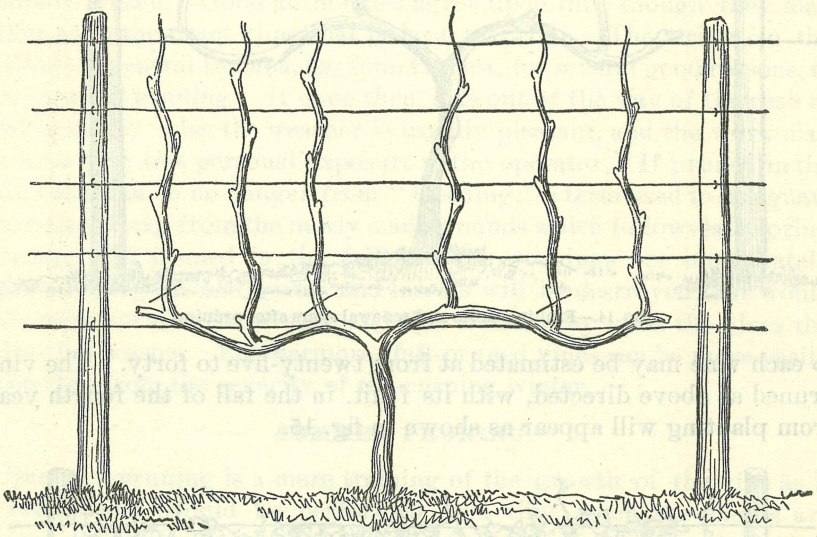

FIG. 13.—Fruiting and renewal canes.

pruning before entering upon its winter's rest and preparatory to bearing a full crop in its fourth year. It will then appear as illustrated in fig. 13.

RENEWAL PRUNING.

Each alternate upright cane on the horizontal arms must be cut down to a short spur at a point near the arm, and the others cut off even with the top wire of the trellis. Its appearance will then be somewhat like the accompanying illustration. (Fig. 14.)

The following spring a single shoot is allowed to grow from each of the spurs on the horizontal arms to be trained vertically to the wires above, and the eyes (from six to ten) on the canes that are left from the previous pruning will send out the fruit-bearing shoots for the current year. These fruit-bearing shoots are to be trained on the wires of the trellis, and may be allowed to bear one or two bunches

of fruit each. If there are six eyes or buds on each upright cane, and there are three or four of these, the number of bunches of fruit

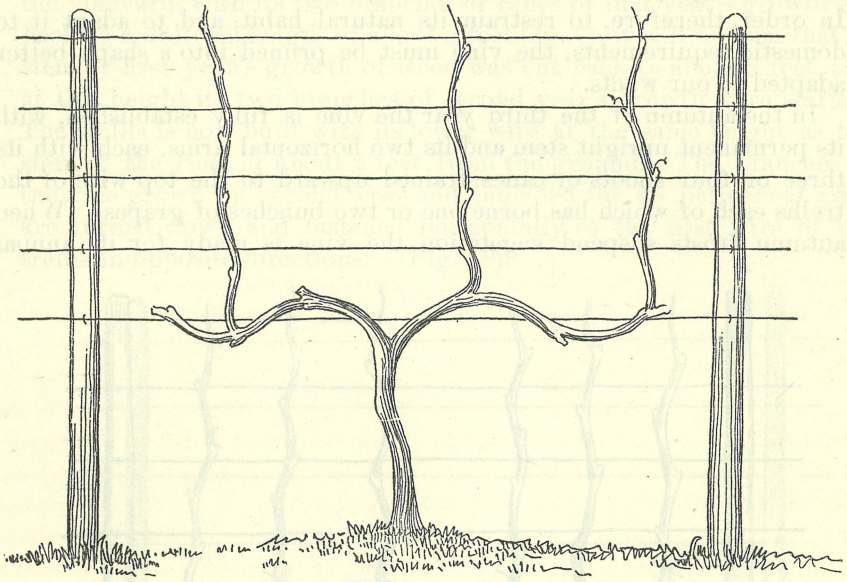

FIG. 14.—Fruiting canes and renewal spurs after pruning.

to each vine may be estimated at from twenty-five to forty. The vine pruned as above directed, with its fruit, in the fall of the fourth year from planting will appear as shown in fig. 15.

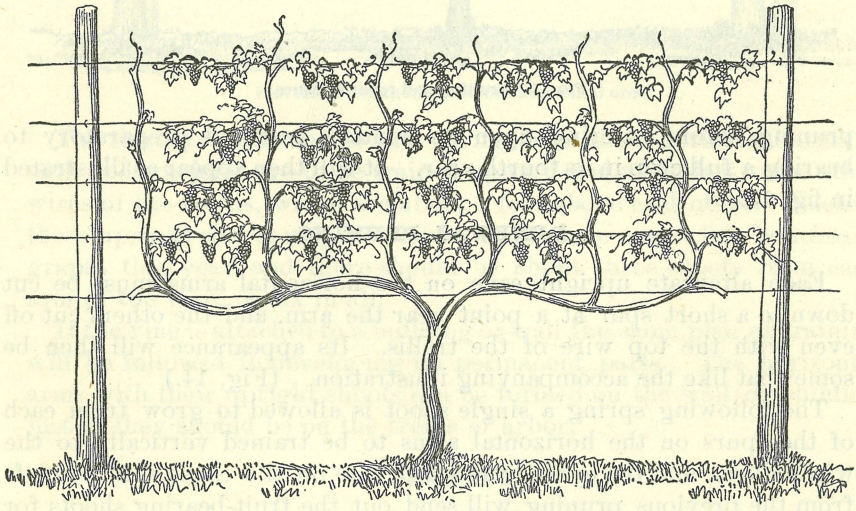

FIG. 15.—Fruiting and renewal canes.

When the grapes have been harvested and the season (late fall or early winter) has again come for the annual pruning, the canes that

have borne fruit are to be cut down to short spurs, a few inches from the horizontal arms, and the shoots that have grown from the spurs of the preceding year are to be retained for fruiting the succeeding season. In this way new wood, that is absolutely necessary to the production of fruit, is always provided for each succeeding year, and that, too, within the limited space allotted to each vine.

WHEN TO PRUNE.

An annual pruning should be given all grapevines at some time during the period of rest, between the late fall frosts and the early movement of sap the following spring, but never prune when the wood is actually frozen. Good authorities agree upon this, though they may differ as to the exact time that is best to prune. The writer, in the latitude of central Indiana, has found it best, for several good reasons, to practice fall pruning. If done then, it is out of the way of the rush of spring work. Also the weather is usually pleasant, and the work may be done with less personal exposure to the operator. If pruned in the fall, there can be no danger from "bleeding," a term used to designate the waste of sap from the newly made wounds which follows late spring pruning. If pruned in the fall and the prunings are immediately burned, many disease germs and insects will be destroyed that would otherwise survive the winter, and that would prey upon the vines the following season. Furthermore, fall-pruned vines can be more easily protected from the severity of the ensuing winter.

SUMMER PRUNING.

Summer pruning is a mere training of the growth of the vine as it develops, and should be performed at a time when the shoots are young and tender, so that superfluous buds may be readily pinched or broken off with the thumb and fingers. It begins with the beginning of the season's growth, usually in May.

The vine developed as directed has its horizontal arms trained in opposite directions on the first wire of the trellis. On these arms are fruit-bearing canes and renewal spurs. On the fruit-bearing canes, trained upward from the arm to the top of the trellis, there will be from three to six eyes, according to the height of the trellis and the length of the joints of each cane. From each eye only one shoot, and that the most vigorous, is allowed to grow, but these shoots, one from each eye, should be carefully guarded. They are very tender and may be broken off if not supported until sufficiently hardened or until they have clasped the wires with their tendrils. A high wind or even a small bird alighting on it may break off one of these tender shoots, and in that case the fruit prospect at that point is gone for the year. These fruit-bearing shoots should be trained on the wires of the trellis.

The fruit clusters will be borne on these shoots at distances ranging

from 6 to 15 inches from their base. There will be one, two, sometimes three, or even four clusters on each shoot, the numbers varying according to the habits of the variety, etc. The shoot should be pinched back at a point about 10 inches beyond the last bunch of fruit. It will then incline to throw out laterals or side branches. They, too, should be pinched off at the second or third leaf from their base. This will be all the summer pruning the bearing wood will require.

Again, at the beginning of the season a single bud is allowed to start from the renewal spur made by cutting away the cane that had borne fruit the year before, and occurring on the horizontal arms alternating with the fruit-bearing canes of the current year. This should be trained up to the top of the trellis, and all the side shoots or laterals that are thrown out from it should be broken off. This shoot is for the bearing wood the succeeding year, after the wood that has borne fruit this year is cut away to form the renewal spur as before.

A vine trained as directed, with bearing wood, fruit, and the newly grown cane for the following year's fruit will appear as shown in figure 15. After it has been pruned by cutting away the wood that has borne fruit this year and cutting back the canes for next year's fruiting even with the top wire of the trellis it will appear as shown in figure 14.

VARIETIES TO PLANT.

THE BEST GRAPES FOR HOME PLANTING.

The principles that form the basis of vineyard management are general and simple. With the selection of varieties, however, it is very different. Their behavior and requirements are varied according to climate, soil, exposure, etc., so that it would be the sheerest presumption, without personal and practical experience, to offer a list for the planter in any given section. A few varieties, however, can be grown successfully in many parts of the North. Among these none have yet surpassed the well-known Concord and its seedlings, the Worden and the Moore, syn. *Moore's Early*, both black, and the Niagara, a white or green grape.

It is worthy of note that a summary of answers to inquiries sent out from this office within recent years to hundreds of practical fruit growers from Maine to California, shows that, with one exception (that being the Delaware), the Concord and its three seedlings, named above, received the widest range of recommendations given any hardy grapes.

The Delaware is of the highest quality of fruit, indeed, the standard of excellence among our native grapes, yet it is always to be understood that it is recommended with qualifications. In a very few localities, with special care and skill in its culture, it is a leading market, as

well as home variety, but the inexperienced grower is not likely to succeed with it. Therefore it can not be recommended to him for general planting.

The Catawba is one of the oldest and best known of native varieties. It is a very late grape and of recent years has succeeded well in only a few favored localities. Where it still succeeds nothing better can be planted for late use.

Other varieties which are worth mentioning in this connection are Brighton, Cottage, Diamond, Elvira, Ives, Janesville, Moyer, Pocklington, Salem, Winchell, syn. *Green Mountain*, and Woodruff. But these are recommended only for certain localities where they have been tried, or to persons who are willing to risk a failure for the sake of the chance of getting something especially good and more or less rare.

SACKING GRAPES.

Grapes have a number of enemies; some are of fungous origin, others are insects, and still others are birds. They may be effectually protected and shielded from many enemies by the proper use of sacks. The sacks recommended for use are made of tough paper, and may be purchased cheaply by the thousand, if necessary, from dealers in supplies of this character. They are such as grocers use for putting up small packages for their customers. Those holding about 1 quart, known as 2-pound sacks, are a good size for most varieties of the grape. A few varieties having very large clusters may require larger sacks.

A single sack is to be placed over each cluster and made fast by the use of a pin, small wire, or tie of some kind and allowed to remain there until the fruit is ripe and ready for use. To be thoroughly effectual as a safeguard against the attacks of disease and insects the sack must be placed over the cluster soon after the blooming season is past; if possible, before the young grapes are larger than bird shot. A little delay will often give the germs of disease and depredating insects an opportunity to plant themselves on or in the newly formed fruit, when the sacks will fail to perform the good service expected of them.

The sacks are easily and quite rapidly applied, especially where the vines are properly trained, as the fruit clusters will then be in easy reach of the operator and will be much fewer in numbers and of better size than if the vines were neglected. The expense of sacks and labor is trifling, and the good results are beyond question. They may be summarized as follows: Sacks protect grapes from rot and mildew; from various insects, including bees, wasps, hornets, and flies of all kinds, and from the sting of the grape moth and curculio that produces the larva or worm that is so often found within the berry itself, and they protect them from the attacks of several kinds of birds that

break the skin of grapes and invite further injury by bees and insects and from chickens. Grapes that have been sacked are always clean and free from dust and smoke, and being sound may be allowed to remain for use much longer on the vine than those not sacked. Indeed, they may remain on the vine until they are in danger of being frozen, and if then cut when dry and laid away in a cool, well-ventilated room, with the sacks on, they may be kept for use for a long time after grapes that were not sacked are gone.

The operator—perhaps the farmer's wife or daughter—equipped with sacks and pins or wires, slips the open mouth of a sack over the newly formed cluster of grapes and folding it down about the stem pins it in place or makes it fast by passing a very small piece of pliable wire around the neck of the sack and the work is done. The pins can be of the cheapest make, or if wire is used it should be cut beforehand into lengths of about 4 inches. The mouth of the sack must be carefully folded about the stem of the bunch, or otherwise it may admit insects or disease germs or even rain water that will sometimes fail to find its way out through the sack, and would thus spoil the fruit. A little practice will soon render the operator expert in affixing the sacks.

INSECT ENEMIES AND THEIR REMEDIES.

The grape is subject to the attack of various diseases and insect enemies. For descriptions of insect enemies of the grape and remedies therefor see Farmers' Bulletin No. 70, which is entirely devoted to that subject, and which may be had free on application to the Secretary of Agriculture.

FUNGOUS DISEASES AND TREATMENT.

The principal diseases affecting the grape east of the Rocky Mountains are black rot, downy mildew, powdery mildew, and anthracnose.

Of the various preparations used for those diseases none has been found which fills so many requirements as Bordeaux mixture and the ammoniacal solution of copper sulphate. Farmers' Bulletin No. 38, Spraying for Fruit Diseases, contains the following directions in relation to the preparation and use of these mixtures:

PREPARATION OF MIXTURES FOR SPRAYING.

Bordeaux mixture.—All things considered, it is believed that the best results will be obtained from the use of what is known as the 50-gallon formula of this preparation. This contains—

Water	50 gallons.
Copper sulphate	6 pounds.
Unslacked lime	4 pounds.

It has been found that the method of combining the ingredients has an important bearing on both the chemical composition and physical structure of the mixture.

For example, if the copper sulphate is dissolved in a small quantity of water and the lime milk diluted to a limited extent only, there results, when these materials are brought together, a thick mixture, having strikingly different characters from one made by pouring together weak solutions of lime and copper sulphate. It is true, furthermore, that if the copper sulphate solution and lime milk are poured together while the latter or both are warm, different effects are obtained than if both solutions are cool at the moment of mixing. Where the mixture has been properly made there is scarcely any settling after an hour, while the improperly made mixture has settled more than half.

Briefly, the best results have been obtained from the use of the Bordeaux mixture made in accordance with the following directions: In a barrel or other suitable vessel place 25 gallons of water. Weigh out 6 pounds of copper sulphate, then tie the same in a piece of coarse gunny sack and suspend it just beneath the surface of the water. By tying the bag to a stick laid across the top of the barrel further attention will be avoided. In another vessel slack 4 pounds of lime, using care in order to obtain a smooth paste, free from grit and small lumps. To accomplish this it is best to place the lime in an ordinary water pail and add only a small quantity of water at first, say a quart or a quart and a half. When the lime begins to crack and crumble and the water to disappear, add another quart or more, exercising care that the lime at no time gets too dry. Toward the last considerable water will be required, but if added carefully and slowly a perfectly smooth paste will be obtained, provided, of course, the lime is of good quality. When the lime is slacked add sufficient water to the paste to bring the whole up to 25 gallons. When the copper sulphate is entirely dissolved and the lime is cool, pour the lime milk and copper sulphate solution slowly together into a barrel holding 50 gallons. The milk of lime should be thoroughly stirred before pouring. The method described insures good mixing, but to complete this work the barrel of liquid should receive a final stirring, for at least three minutes, with a broad wooden paddle.

It is now necessary to determine whether the mixture is perfect—that is, if it will be safe to apply it to tender foliage. To accomplish this two simple tests may be used. First insert the blade of a penknife in the mixture, allowing it to remain there for at least one minute. If metallic copper forms on the blade, or, in other words, if the polished surface of the steel assumes the color of copper plate, the mixture is unsafe and more lime must be added. If, on the other hand, the blade of the knife remains unchanged, it is safe to conclude that the mixture is as safe as it can be made. As an additional test, however, some of the mixture may be poured into an old plate or saucer, and while held between the eyes and the light the breath should be gently blown upon the liquid for at least half a minute. If the mixture is properly made, a thin pellicle, looking like oil on water, will begin to form on the surface of the liquid. If no pellicle forms, more milk of lime should be added.

Ammoniacal solution of copper carbonate.—This preparation, as now generally used, contains—

Water	45 gallons.
Strong aqua ammonia	3 pints.
Copper carbonate	5 ounces.

The copper carbonate is first made into a thin paste by adding a pint and a half of water. The ammonia water is then slowly added, and if of the proper strength, i. e., 26 degrees, a clear, deep-blue solution is obtained, which does not become cloudy when diluted to 45 gallons.

The ammoniacal solution of copper carbonate being a clear liquid, its presence on the leaves, fruit, and other parts of the treated plants is not so noticeable as where the preparations containing lime are used.

In case it is desired to keep the strong solution as a stock preparation, the bottle or jug in which it is placed should be tightly corked.

APPLYING FUNGICIDES.

To obtain the best results from the use of a fungicide it is necessary that it should reach all parts of the plant subject to the attacks of the fungous parasites.

Black rot.—Clean the vineyard thoroughly in the spring, burning all trimmings, rotten berries, dead leaves, etc. When the buds begin to open, spray with Bordeaux mixture, taking care to wet the new growth and fruit-bearing wood. In ten or twelve days make a second spraying, and follow this with a third as soon as the fruit is well set. In case of rainy weather, additional treatments should be made, at intervals of twelve or fifteen days, until the fruit begins to show signs of ripening. In an average season six treatments are usually necessary to hold the disease in check. In case of much rain, however, eight sprayings would better be given.

As a modification of the foregoing treatment, the first three applications may be made with Bordeaux mixture, while for the others the ammoniacal solution may be used. The only advantage in this case is that there is not so much likelihood of having stained fruit at the harvest. If the Bordeaux mixture is properly made and applied, there need be little trouble from this source.

Downy mildew.—Downy mildew may be successfully combated by the methods recommended for black rot. In fact, where the two diseases occur together, as they do to a greater or less extent throughout the grape-growing regions of the Eastern United States, treatment for the one will answer for the other. In some sections downy mildew and brown rot of the berries, which are due to the same fungus, occur alone, and in such cases the ammoniacal solution will be found an effective remedy. The fungus of downy mildew and brown rot usually comes on later than the one causing black rot, and for this reason the treatments need not begin so early where downy mildew occurs alone. The first spraying should be made soon after the fruit forms, and other applications should follow at intervals of twelve or fifteen days, as recommended for black rot.

Powdery mildew.—This disease seldom does much injury, as it usually comes on late in the season. In regions where it is known to prevail every year, applications of ammoniacal solution will doubtless hold the parasite in check. Flowers of sulphur has also been extensively used; in fact, on the Pacific coast and in graperies this is almost the only remedy applied.

Anthracnose.—This is quite a serious disease in some sections, and as yet has not yielded as readily to treatment as other grape maladies. The directions given for black rot should be followed in combating this disease, using Bordeaux mixture throughout the work. In addition, the vines should be carefully examined before the leaves put out, and whenever the large scars produced by the fungus are seen they should be cut out. Good results have followed the use of a strong solution of iron sulphate applied to the wood during the winter. The solution may be made by pouring a pint of sulphuric acid upon 25 pounds of iron sulphate and then slowly adding 50 gallons of water. In no case should this preparation be used after the growth starts.

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